Memo

To: NPDES Permit Writers

From: Tom Atkinson

Date: December 14, 2010

Re: Deriving effluent limitations from the Des Moines River Nitrate TMDL

A Total Maximum Daily Load (TMDL) has been prepared by the department and approved by EPA Region VII that addresses drinking water use impairments, caused by elevated levels of nitrates, of the Des Moines River upstream of the Center Street Dam in Des Moines to the Interstate 80 Bridge. The approved TMDL specifies wasteload allocations for nitrate for point sources in the watershed. The wasteload allocations in the TMDL are expressed as daily mass loads of nitrate for two different flow regimes (tiers). The Tier I WLA applies when stream flows at the USGS gauge are greater than or equal to 742 cfs and Tier II WLA apply at flows less than 742 cfs. This procedure addresses how the department will implement this TMDL and the associated wasteload allocations in a manner that is consistent with the Raccoon River and Cedar River TMDLs that address drinking water use impairments caused by elevated levels of nitrates.

In light of the decision by the U.S. Court of Appeals for the D.C. Circuit in *Friends of the Earth, Inc. v. EPA, et al.*, the TMDL must specify the total maximum daily loads as "daily" loads. The EPA issued a memo on November 15, 2006 which discusses the implications the *Friends of the Earth* decision has on NPDES permits. This memo notes that the decision does not affect the NPDES permitting authority's ability to use all available tools to translate TMDLs and their wasteload allocations into enforceable effluent limitations in discharge permits.

The Tier II wasteload allocations for nitrate in the Des Moines River TMDL were set as the estimated current discharges, recommending no reductions from point source discharges. These estimates were calculated in various ways depending on available information and the type of discharger, which resulted in estimated average daily discharges from each facility. 1) For facilities with a design capacity for TKN identified in the Construction Permit process, this capacity was set as the estimated daily load, 2) For many facilities the 2000 census population was multiplied by 0.027 lbs of TKN/ca/day, which is an accepted literature value for the amount of nitrogen contributed to domestic wastewater by each person. When no population data was available the population equivalent based on historic flow data was used, 3) If organic industrial waste was present this was used or added to the estimate for a POTW, 4) For water treatment plants the discharge flow (estimated as 10% of the water used) was multiplied by 9.5 mg/l (WQS –margin of safety).

Since the Tier II WLA values were average values, the TMDL used the permit derivation procedure as described in the TMDL implementation procedures for the Cedar River Nitrate TMDL and the Raccoon River Nitrate TMDL to calculate the daily maximum WLA (Tier I WLA).

For the purpose of trying to implement similar TMDLs in a consistent manner, the following procedures are detailed to implement the Des Moines River Nitrate TMDL in a similar fashion as the Cedar River and Raccoon River Nitrate TMDLs.

Attachment #1 lists the tiered WLAs and the nitrate limits which were derived from the WLAs listed in the Des Moines River Nitrate TMDL using the following procedures and the data available as of the date of this memo.

The TMDL reserved allocations for water treatment plants that are known to exist, but were unpermitted at the time of TMDL development and also for unsewered communities that may provide centralized treatment in the future. When permitting a facility that was included in the reserved WLA, a specific WLA shall be calculated using the applicable method from the TMDL and permit limits shall be calculated as detailed in the following procedures.

FOR CONTINUOUS DISCHARGE FACILITIES

The EPA (1991) *Technical Support Document for Water Quality-Based Toxics Control* contains the statistical permit limit derivation procedure. The department utilizes a similar procedure, found in the *Supporting Document for Iowa Water Quality Management Plans,* to derive WQBELs. Due to the procedures used to calculate the Tier II wasteload allocations in the Des Moines River Nitrate TMDL, the Tier II wasteload allocations shall be used as the long-term average (LTA) in the permit derivation procedure. The Tier I WLAs were calculated using these procedures and can be used as the maximum daily limit (MDL). Using the multipliers in the tables in Attachment #2, the average monthly limit (AML) can be calculated. The MDL and AML, calculated as of the date of this memo, are listed in Attachment #1.

The multiplier used is dependent on factors such as effluent variability, number of samples collected per month, and the targeted percentile of occurrence probability. For this procedure, the LTA multipliers for both the MDL and AML calculations shall be based on the 99th percentile occurrence probability. The effluent variability is expressed as the coefficient of variability (CV). Because there is a very limited amount of data that is available, the default CV of 0.6 shall be used until more data is available. At the time sufficient data (at least 10 data points) are available the CV can be calculated by dividing the standard deviation of the data by the average of the data. For purposes of determining the LTA multiplier for the AML, the number of samples per month shall be four unless more frequent sampling is required.

For example, the Tier II wasteload allocation in the TMDL for the City of Rolfe WWTP is 17.3 lbs/day. Using the default CV of 0.6 and four samples per month, the monthly LTA multiplier is 1.9. Using this information, effluent limitations are calculated as follows:

AML = 17.3 lbs/day * 1.9 = 32.9 lbs/day
MDL = Tier I WLA = 53.8 lbs/day

Effluent limits that are calculated using this procedure are deemed to be consistent with the assumptions and requirements of the wasteload allocations in the TMDL.

NPDS

Monitoring requirements shall be added for nitrate as follows:
WW Parameter = NITRATE NITROGEN (AS N); Monitoring Location = FINAL EFFLUENT; Sampling Frequency = Per Chapter 63 – Table II for TKN (For facilities with a population equivalent (P.E.) less than 501, the Sampling Frequency should be 1 EVERY 2 MONTHS and for facilities with a P.E. between 501 and 3,000 the frequency should be 1/MONTH); Sample Type = 24 HOUR COMPOSITE; Basis for Monitoring = BPJ; Limits Basis = WATER QUALITY STANDARDS/WLA; Season Indicator = Yearly; Concentration Units = MG/L; Mass Units = LBS/DAY. The limits calculated above shall be entered as 30 Day Average and Daily Maximum mass limits.

FOR CONTROLLED DISCHARGE LAGOON FACILITIES

Although this TMDL specifies maximum daily loads for controlled discharge lagoon facilities, for the purpose of consistency, the WLA shall be converted to an annual load and limited as pounds per year. The annual load values were calculated by multiplying the Tier II WLA by 365, and are listed in the Annual Load for CDL (lbs nitrate/year) column of Attachment #1. This procedure addresses how the department will implement this TMDL and associated wasteload allocations to regulate the nitrate discharge on an annual basis from controlled discharge lagoons.

A new parameter has been created in the NPDS database named 'Annual Nitrate Nitrogen Discharged' (ANN NO3-N). Permits will specify a monitoring location of 'Final Effluent', a monitoring frequency of once every 12 months, a sample type of 'Calculated', a monitoring basis of 'Best Professional Judgment', a limits basis of 'WATER QUALITY STANDARDS/WLA' , a season indicator of 'Yearly' and mass units of 'lbs/year'. The wasteload allocation from the approved TMDL has been converted to lbs/year and has been identified in Attachment #1. The Annual Load (lbs nitrate/year) shall be included in the database as a daily maximum mass limit for this parameter.

The following special monitoring requirement will also be included under the parameter ANN NO3-N.

Annual Nitrate Nitrogen:
The annual nitrate nitrogen discharge limit on Page 3 of this permit is not a daily maximum but rather the total pounds of nitrate nitrogen that can be discharged during a calendar year (January – December). The total pounds of nitrate nitrogen discharged per year shall be the sum of the lbs of nitrate nitrogen discharged during each month that a discharge occurred. You must report the total pounds per year of nitrate nitrogen discharged during the previous calendar year in the column labeled "ANN NO3-N" on the February Monthly Operating Report (MOR) each year.

In addition to limits and reporting of the annual amount of nitrate nitrogen discharged, permits will also specify monitoring (no limit) for the parameter Nitrate Nitrogen (as N) on the final effluent with a monitoring frequency based on Chapter 63, Table 1 for ammonia nitrogen {once or twice per drawdown depending on design PE}. The sample type will be 'Grab'.

The following special monitoring requirements will be included under the parameter NITRATE NITROGEN (AS N).

The discharge flow shall be reported for each day discharge occurs in the column labeled "FLO-OUT" on the Monthly Operating Report (MOR). The concentration of nitrate nitrogen shall be reported for each day a sample is collected and analyzed for nitrate nitrogen.

The total pounds of nitrate nitrogen discharged shall be calculated for each calendar month during which there is a discharge and shall be reported in the comments section of the Monthly Operating Report (MOR). The lbs of nitrate nitrogen discharged during a calendar month shall be calculated as follows:

*Average daily flow for the month (MGD) * Average nitrate nitrogen concentration (mg/L) * 8.34 * Number of days discharge occurred during the month = total lbs of nitrate nitrogen per month*

ATTACHMENT #1

Facility Name	Tier I Maximum Daily Nitrate Load (lbs/day)	Tier II Average Daily Nitrate Load (lbs/day)	MDL (lbs nitrate/day)	AML (lbs nitrate/day)	Annual Load for CDL (lbs nitrate/year)
Algona, City of	712.19	229	712	435	
Armstrong, City of	102.63	33	103	63	
Ayrshire, City of	16.9495	4.45	17		1624
Badger, City of	51.2217	16.47	51		6012
Bancroft, City of	67.8602	21.82	68		7964
Barnum, City of	16.3897	5.27	16		1924
Bode, City of	27.4613	8.83	27		3223
Boone, City of	1075.0648	345.68	1075	657	
Boxholm, City of	18.0691	5.81	18		2121
Brit, City of	172.294	55.4	172	105	
Brushy Creek State Park North Campground, DNR	4.354	1.4	4		511
Burt, City of	46.6811	15.01	47		5479
Camp Hantesa	1.8349	0.59	2	1	
Camp Dodge	78.0921	25.11	78	48	
Clare, City of	15.9543	5.13	16		1872
Clarion, City of	276.79	89	277	169	
Coats Utilities	12.1912	3.92	12		1431
Corwith, City of	52.87	17	53	32	
Cylinder, City of	9.2367	2.97	9		1084
Dakota City, City of	301.67	97	302	184	
Dayton, City of	74.2357	23.87	74		8713
Duncombe, City of	39.808	12.8	40		4672
Eagle Grove, City of	559.8	180	560	342	
Easter Seal Camp Sunnyside	2.6124	0.84	3		307
Emmetsburg, City of	653.1	210	653	399	
Estherville, City of	1921.669	617.9	1922	1174	
Fort Dodge, City of	6220	2000	6220	3800	
Gilmore City, City of	46.6811	15.01	47		5479
Goldfield, City of	57.0996	18.36	57		6701
Graettinger, City of	75.573	24.3	76		8870
Grand Junction, City of	80.9533	26.03	81		9501
Granger, City of	108.85	35	109	67	
Grimes, City of	942.33	303	942	576	
Gruver, City of	8.8946	2.86	9		1044
Humboldt, City of	441.62	142	442	270	
Jester Park 1, Polk County Conservation	16.794	5.4	17	10	
Jester Park 2, Polk County Conservation	16.8562	5.42	17	10	
Kanawha, City of	62.0445	19.95	62		7282
Koch Nitrogen Plant	99.6755	75.92	100	144	
Lake Cornelia Sanitation District	19.4686	6.26	19		2285
Lehigh, City of	41.7362	13.42	42		4898
Livermore, City of	36.2004	11.64	36		4249
Madrid, City of	301.67	97	302	184	
Mallard, City of	25.0355	8.05	25		2938
Oak Lake Maintenance, Inc.	25.8752	8.32	26	16	
Ogden, City of	292.34	94	292	179	
Otho, City of	47.9562	15.42	48		5628
Pilot Mound, City of	0	0			*
Pocahontas, City of	286.12	92	286	175	
Polk City, City of	196.8319	63.29	197	120	
Renwick, City of	25.6886	8.26	26		3015
Ringsted, City of	36.6047	11.77	37		4296
Rolfe, City of	53.803	17.3	54		6315
Rutland, City of	12.1912	3.92	12		1431
Savage Sanitation District, Fort Dodge	83.7212	26.92	84	51	
Saylorville Bob Shelter	8.0549	2.59	8		945
Scenic Valley Conference Center and Camp, Inc.	8.0549	2.59	8		945
Southdale Addition, Algona	2.1148	0.68	2	1	

ATTACHMENT #1

Facility Name	Tier I Maximum Daily Nitrate Load (lbs/day)	Tier II Average Daily Nitrate Load (lbs/day)	MDL (lbs nitrate/day)	AML (lbs nitrate/day)	Annual Load for CDL (lbs nitrate/year)
South Oak Estates, Algona	3.11	1	3	2	
Stratford , City of	62.6354	20.14	63		7351
Swea City, City of	53.8963	17.33	54		6325
Thor, City of	14.617	4.7	15		1716
Titonka, City of	49.0447	15.77	49		5756
US Gypsum	7.464	2.4	7	5	
Van Diest Industry	10.574	3.4	11	6	
Vincent, City of	13.2797	4.27	13		1559
Wallingford, City of	17.6337	5.67	18		2070
Webster City, City of	1244	400	1244	760	
Wesley, City of	39.2171	12.61	39		4603
West Bend, City of	70.0372	22.52	70		8220
Whittemore, City of	44.5041	14.31	45		5223
Woodward, City of	220.81	71	221	135	
Woodward Resource Center	40.9898	13.18	41		4811
Woolstock, City of	17.105	5.5	17		2008
YMCA Boone	5.7846	1.86	6	4	

*Pilot Mound has not reported recent discharges, but a WLA and limits could be calculated consistent with the TMDL implementation.

ATTACHMENT #2

Monthly LTA Multiplier

Average Monthly Limit (AML)

$$AML = LTA \cdot e^{[z\sigma_n - 0.5\sigma_n^2]}$$

where: $\sigma_n^2 = ln[CV^2/n + 1]$.

z = 1.645 for 95th percentile occurrence probability, and

z = 2.326 for 99th percentile occurrence probability

n = number of samples/month

	LTA multipliers $e^{[z\sigma_n - 0.5\sigma_n^2]}$									
	95th percentile					99th percentile				
CV	n=1	n=2	n=4	n=8	n=30	n=1	n=2	n=4	n=10	n=30
0.1	1.17	1.12	1.08	1.06	1.03	1.25	1.18	1.12	1.08	1.04
0.2	1.36	1.25	1.17	1.12	1.06	1.56	1.37	1.25	1.16	1.08
0.3	1.55	1.38	1.26	1.18	1.09	1.90	1.59	1.40	1.24	1.13
0.4	1.75	1.52	1.36	1.25	1.12	2.27	1.83	1.55	1.33	1.18
0.5	1.96	1.66	1.45	1.31	1.16	2.68	2.09	1.72	1.42	1.23
0.6	2.13	1.90	1.55	1.38	1.19	3.11	2.37	1.90	1.52	1.28
0.7	2.31	1.94	1.65	1.45	1.22	3.56	2.66	2.08	1.62	1.33
0.8	2.48	2.07	1.75	1.52	1.26	4.01	2.96	2.27	1.73	1.39
0.9	2.64	2.20	1.85	1.59	1.29	4.46	3.28	2.48	1.84	1.44
1.0	2.78	2.33	1.95	1.66	1.33	4.90	3.59	2.68	1.96	1.50
1.1	2.91	2.45	2.04	1.73	1.36	5.34	3.91	2.90	2.07	1.56
1.2	3.03	2.56	2.13	1.80	1.39	5.76	4.23	3.11	2.19	1.62
1.3	3.13	2.67	2.23	1.87	1.43	6.17	4.55	3.34	2.32	1.68
1.4	3.23	2.77	2.31	1.94	1.47	6.56	4.86	3.56	2.45	1.74
1.5	3.31	2.86	2.40	2.00	1.50	6.93	5.17	3.78	2.58	1.80
1.6	3.38	2.95	2.48	2.07	1.54	7.29	5.47	4.01	2.71	1.87
1.7	3.45	3.03	2.56	2.14	1.57	7.63	5.77	4.23	2.84	1.93
1.8	3.51	3.10	2.64	2.20	1.61	7.95	6.06	4.46	2.98	2.00
1.9	3.56	3.17	2.71	2.27	1.64	8.26	6.34	4.68	3.12	2.07
2.0	3.60	3.23	2.78	2.33	1.68	8.55	6.61	4.90	3.26	2.14

EPA